

*Issue6, May 2016*

We hope the AOSWA framework helps  
our activities for improving space weather activities.

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# AOSWA *Link*

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## **Your contribution is always welcome!**

If you should wish to submit an article, you are greatly appreciated. The articles should be approximately 500 words and contain either figures or pictures. Also It is available for use as a means of spreading information, such as upcoming conference and so on. Your feedback is always welcome.

Contact : [sw-project-office@ml.nict.go.jp](mailto:sw-project-office@ml.nict.go.jp)

# Summary of the International Reference Ionosphere 2015 (IRI 2015) Workshop, Bangkok, Thailand

*Pornchai Supnithi, Prasert Kenpankho Space and Atmospheric Communication and Informatics Laboratory, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand*



The International Reference Ionosphere 2015 (IRI 2015) Workshop was held on the campus of King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand, from 2 to 13 November, 2015. The theme of this Workshop is "Improved Accuracy of IRI at Equatorial Latitudes and Progress Towards Real-Time IRI." This was the first time it was held in the Southeast Asian (ASEAN) region. The event consisted of the Training week (2-6 November), followed by the Presentation Week (9-13 November). The sponsors included Committee on Space Research (COSPAR), KMITL, Geo-Informatics and Space Technology Development Agency (GISTDA), AOSWA, ECTI Association among others.

## Training Week: 2-6 November, 2015

Ten lecturers and thirty-three trainees participated in the 5-day Training session. The Trainees were competitively selected from 114 applicants and represented 11 countries. On each Training day, lectures were given in the morning, while the afternoons were devoted to the database, data analysis as well as Team Projects. The lecturers are Profs. Bodo Reinisch and Ivan Galkin (University of Massachusetts, USA), Prof. Dieter Bilitza (George Mason University, USA), Assoc. Prof. Pornchai Supnithi (KMITL), Asst. Prof. Prasert Kenpankho (KMITL), Prof. Andrzej Krankowski (University of Warmia and Mazury, Poland), Prof. Shigeto Watanabe (University of Hokkaido, Japan), Dr. Vladimir Truhlik (Institute of Atmospheric Physics, Czech Republic), Dr. Takashi Maruyama (National Institute of Information and Communications Technology, Japan), Dr. Susumu Saito (Electronic Navigation Research Institute, Japan).





*Group photo, Nov. 2<sup>nd</sup>, 2015*

The lecture topics during the training week were: Ionosphere-An introduction, IRI-Introduction and open problems, Comparison of IRI with ionosonde data from the Asian sector, IRIweb and related online services, Ionosonde measurements, Real-Time IRI, Ionosondes in the Asian Sector, Ionosonde data online: GIRO and SPIDR, GNSS data and ionospheric studies, Irregularities at equatorial latitudes, TEC comparisons with IRI in the Asian sector, Access to GNSS data, Coupling between ionosphere and thermo-



*Atmosphere in the lecture/computer room*

sphere at low latitudes, Ion densities and plasma temperatures, Solar irradiance and Upper atmospheric chemistry, Incoherent scatter radar, and Ionospheric storms.

On the first training day the trainees were divided into 8 teams and the 8 science problems were distributed to the teams via lottery. A lecturer was assigned to each problem to work as an adviser with the specific team. Below are the topics/problems assigned to each team.

### List of Problems

- Problem 1:** Compare the annual and semi-annual variation of foF2 in the two hemispheres. What are the differences? What could be possible causes? What does IRI predict?
- Problem 2:** Compare the annual and semi-annual variation of foF2 in the two hemispheres. What are the differences? What could be possible causes? What does IRI predict?
- Problem 3:** Investigate storm effects on foF2, hmF2, and TEC at a location in the Northern hemisphere. What are the differences? What is the storm effect on the slab thickness? Compare with IRI and IRI-Real-Time predictions. Use the Halloween storm (Oct 28 - Nov 1, 2003) or select your own storm event.
- Problem 4:** Investigate storm effects on foF2, hmF2, and TEC at a location in the Southern hemisphere. What are the differences? What is the storm effect on the slab thickness? Compare with IRI and IRI-Real-Time predictions. Use the Halloween storm (Oct 28 - Nov 1, 2003) or select your own storm event.
- Problem 5:** Different profile functions have been proposed for the representation of the topside electron density profile. Which ones are used in IRI and other models? Which give the best results? With each profile type, a different scale height is defined how do they compare to the theoretically expected scale height.



**Problem 6:** How well is the Equatorial Ionization Anomaly (EIA) represented in IRI? Use the EIA parameter model developed by Xiong et al. (2013) based on CHAMP and GRACE data. Compare with EIA parameters determined from IRI. Suggest ways to improve IRI.

**Problem 7:** An East-West Coast difference has been reported over the continental US. Investigate analogous effects in the South-Asian sector. What are the causes for these differences? Are these differences reproduced by IRI?

**Problem 8:** E-region physics. Investigate improvements of the representation of foE and hmE for use in IRI. IRI currently depends on the 12-month running mean of sunspot number. Find out if a daily or monthly index can be used. Do you see a dependence on magnetic activity.



# Training of Space Weather Monitoring Forecasting in NICT, Japan

*Zahira Mohd Radzi & Nyanasegari*



## Introduction

National Space Agency (ANGKASA) is developing infrastructure and facility to monitor space weather effects. Currently ANGKASA is in the progress of developing the Malaysia Space Environment and Space Application Centre (MySES) to provide current condition of solar activity. Prior to the establishment of this center, researchers in ANGKASA are continuously build their capacity knowledge and skill in monitoring and forecasting the space weather conditions.

On March 2015, NICT offered an opportunity for researchers from ANGKASA to apply for funding from NICT to do attachment program under their International Cooperation Promotion Program. With that, both of us attended the Professional Training and Job Attachment on Space Weather Forecasting for 2 months at NICT.

The training in Space Environment Informatics Laboratory started on 07th Sept – 05 Nov 2015. During our two months stay, we concentrated to enhance our knowledge in three areas which includes basics and operation of ionosonde that are placed under SEALION project, deriving plasma bubble from GPS data in GTEX format and Space Weather Monitoring and Forecasting. These three areas were chosen based on the need for Malaysia to provide space weather related information to our stakeholders.

As we knew, few parameters are important for

us to predict the impact on the space weather on Earth. Space weather is predicted based on the time difference between the moment of the solar flare occurred and the time when the high-energy particles released from the event reaching the Earth. When a solar flare occurs on the solar surface, X-rays will take about eight minutes, and high-energy particles will take from less than an hour to a few hours to reach the Earth. While the solar wind may reaches the Earth in about an hour. And a coronal mass ejection takes two to three days. These parameters are used to monitor and predict the space weather.



*Figure 1 : Initial discussion in National Space Centre attended by Dr. Mamoru Ishi and Dr. Hadeketsu Jin in October 2015 led to the most valuable training in NICT*



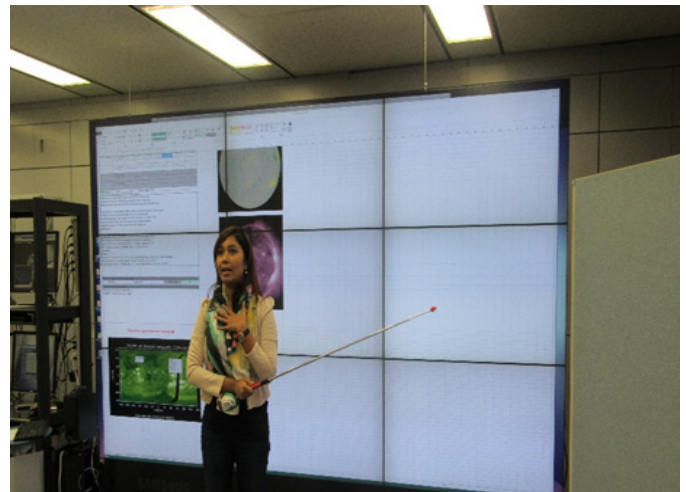
In this training, we managed to conduct our presentation on space weather forecast. In NICT, they conducted a forecast and prediction meeting around 2:30 p.m JST daily to monitor and predict the space weather effect. The forecast includes information about the solar flare activity, geomagnetic activity, and the status of solar energetic particles released from CMEs and reaching the Earth. Besides, they also provide information about the possibility of impact on high-frequency radio communications and satellite operations.

These activities made our training more useful as we also given a chance to present our forecast of the day. With all information and knowledge given within two months finally, we successful presented our forecast. We also realize it is a challenging task for a forecaster to provide daily information on the solar events as it need more practice to achieve the most correct forecast, like a famous proverb say "practice makes perfect".

It was indeed a good experience having the training in NICT. It is a good start on preparing ourselves for the operating our space weather center.



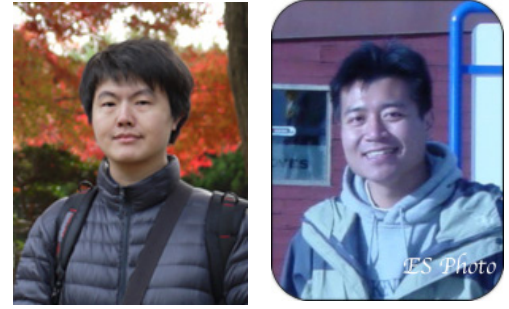
*Figure 2: Explanation and training on the Solar Weather Forecast given by Dr. Yuki Kubo*



*Figure 3: Demonstration of Space Weather Monitoring and Forecast*

# Space Weather Research in NCKU

*Koichi Chen and Charles Lin,  
Department of Earth Sciences, National Cheng Kung University,  
Tainan, Taiwan*



National Cheng Kung University (NCKU) is located in the Tainan City, a historical old capital of Taiwan. The city sitting in the southern part of the island ( $23.0^{\circ}\text{N}$  and  $120.2^{\circ}\text{E}$ ) has a mild and warm weather. It is also located right underneath the northern crest of the Equatorial Ionization Anomaly (EIA), where the plasma density is much greater than other latitudes. During the nighttime, the plasma bubbles are also frequently observed. Both ionospheric effects make the worse conditions for the radio communication and satellite positioning affecting not only in Tainan but also entire Taiwan.

To provide warnings and monitoring of space weather events, a space weather operation program is recently found in Taiwan. The NCKU group contributes to the program by developing an ionospheric space weather forecast model. The ensemble Kalman filter based data assimilation (DA) model assimilates both total electron content (TEC) observed by ground-based GPS network and radio occultation (RO) observations by FORMOSAT-3/COSMIC (F-3/C) satellite. Figure 1 shows an example of the DA output for the space weather event on 17 March 2015 (the St. Patrick's Day Geomagnetic Storm). From the snapshot of global ionospheric TEC distributions during  $\pm 1$ -day of the storm (Fig. 1), the global TEC increases largely during the storm main phase (3/17 1200 UT), comparing with the D-1 day (3/16). Following the TEC enhancements,

significant TEC decreases are seen during the storm recovery phase (3/18). The dynamic variations on the storm-time ionosphere are well captured by the DA model.

The DA model could be further improved with inclusion of more observations, especially the RO soundings. It is expected that the follow-on mission of FORMOSAT-3/COSMIC, called FORMOSAT-7/COSMIC-2 (F-7/C-2), will provide 2 ~ 4 times more RO data than the current mission. The F-7/C-2 mission will launch its six out of twelve satellites into low-inclination orbits in 2016. The Tri-GNSS RO system of F-7/C-2 will be capable of tracking much more high-quality profiles per day. Figure 2 shows the comparison between the 3-hr observation points of F-3/C and that of F-7/C-2. The follow-on mission will provide roughly 4 times more RO data.

In addition to ionosphere forecast model, the all-sky camera system, ground-based GPS receivers and satellite beacon receivers are installed to simultaneously observe the ionospheric plasma bubbles. Fig. 3 shows the all-sky camera system installed at the roof of Tainan Astronomical Education Area (TAEA) to automatically taking image of ionospheric plasma bubbles. The coordinated multiple instrument observations will help monitoring the plasma bubbles for space weather forecast.



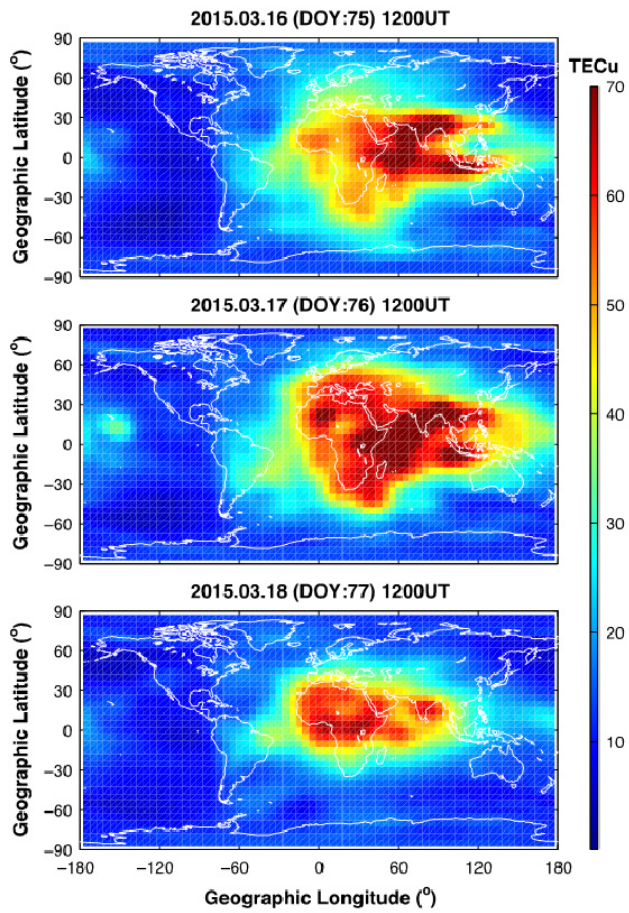


Figure 1. The results of storm time ionospheric TEC by assimilated FORMOSAT-3/COSMIC RO observations at 1200UT on 16 (pre-storm, upper panel), 17 (storm, middle panel), and 18 (after-storm, bottom panel) March 2015.

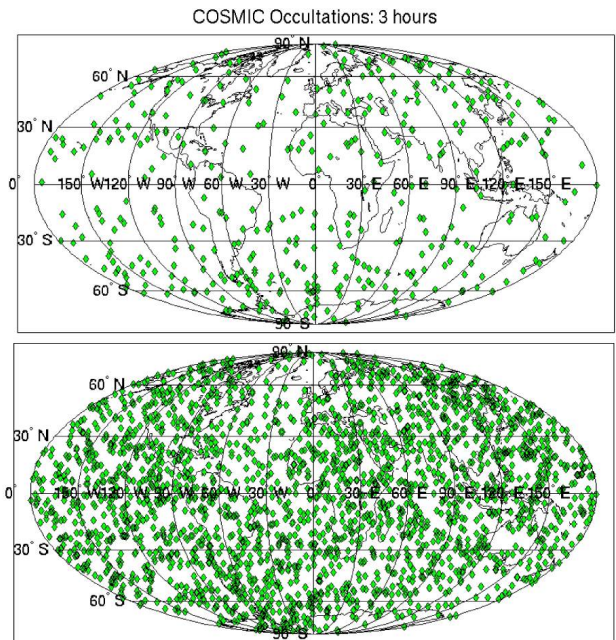


Figure 2. Global RO observations during 3 hours by F-3/C (upper panel) and F-7/C-2 (bottom panel).

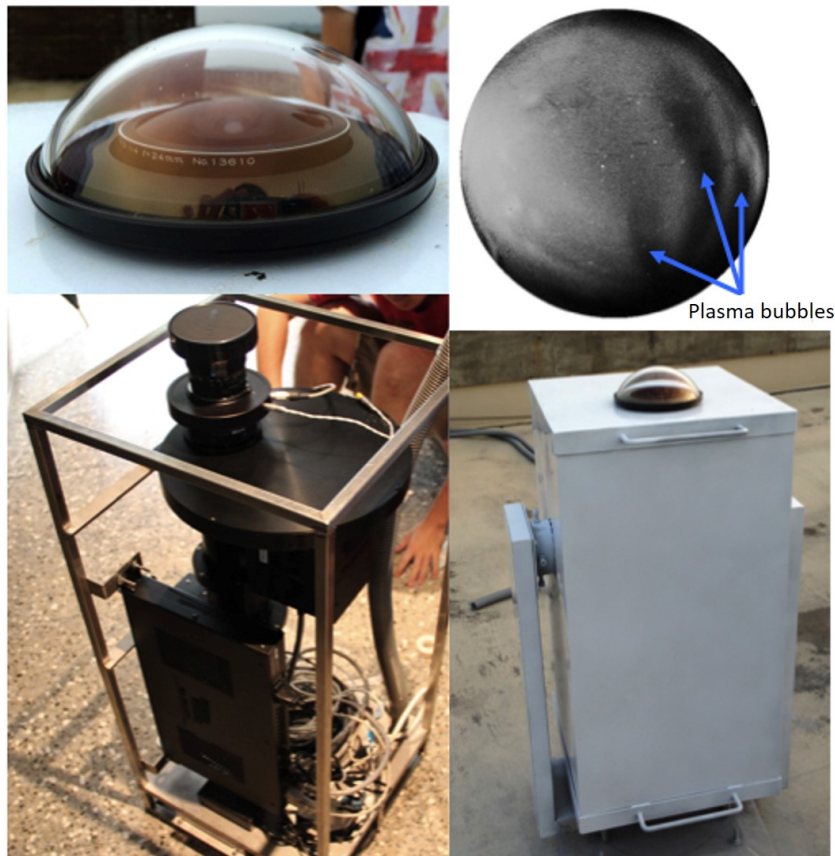


Figure 3. NCKU all-sky camera system and an example of observed plasma bubbles in 630.0 nm.



# The 4<sup>th</sup> AOSWA Workshop

## *“The risk of space weather – Regional action”*

### Oct. 24-27 2016, Jeju, Korea

Wi Gwan-sik,  
Korean Space Weather Center, Korea



I am delighted to invite you to the 4th Asia Oceania Space Weather Alliance (AOSWA) Workshop!

I am Wi Gwan-sik, the Director of the Korean Space Weather Center at the National Radio Research Agency that is the nation's command module for space weather forecasts and alerts and space weather risks. The 4th AOSWA Workshop will be held on October 24 -27 2016 in Jeju, Korea, and the Korean Space Weather Center had the honor and privilege of organizing the workshop.

Under the banner of “The risk of space weather – Regional action,” the workshop will consist of:

- Special sessions where participating countries will present their plans to respond to space weather risks and relevant policies;
- Sessions designed to vitalize international exchanges and cooperation in each area of space weather; and
- General sessions where participating countries and individuals will present their research orientations and outcomes in the field of space weather.

I hope that this workshop will serve as a forum for all those interested in space weather not only in Asia and Oceania but also from

all over the world, where they will be able to seek for international cooperation on the increasing risk of space weather risks and promote research exchanges in space weather.

I look forward to welcoming you to Jeju in October 2016, an island of world-class beauty!

For more information on the workshop, please visit the workshop homepage:

<http://aoswa4.spaceweather.org>

Contact(The 4<sup>th</sup> AOSWA Workshop LOC) :

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## Editor's notes

*Yuko Uchida, Editor of AOSWA LINK*

The 4th AOSWA workshop hosted by KSWC will be held in Jeju, Korea on this October.

Actually I visited KSWC last November as a secretariat of AOSWA.

Although it was beginning of Winter and a bit cold, I really enjoyed the beautiful nature of island and also warm welcome by KSWC people.

I appreciate the all effort of SOC and LOC who is organizing the 4th workshop. I hope the workshop will be successful. Also the workshop lead us to the strong collaboration.

I am really looking forward to seeing you again in Jeju!



*Beautiful rainbow I encountered in Jeju island.*

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## AOSWA LINK is issued by AOSWA Secretariat

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